ratio is equal to about 1. It should be noted that much larger power may be generated in embodiments including bimorphs having metal shims. Furthermore, resonance frequency of EH transducers increased with metal/piezo thickness ratio.

[0114] Energy harvesting may be used in transmitters, for example in transmitters used to pay tolls on a toll road. Self-powered transmitters were tested in several different vehicles driven on a bumpy road and on a smooth road to determine how long it would take to power the transmitter. The particular transmitter used required approximately 1.44 mJ to operate. FIG. **15**A illustrates how long it took the self-powered transmitter to charge while being used in a sport utility vehicle (SUV) driven on a bumpy road. As illustrated, sufficient energy was produced in about 0.3 minutes to about 0.7 minutes depending on the transducer type used. FIG. **15**B illustrates how long it took the self-powered transmitter to charge while being used in a small car driven on a smooth road. As illustrated, sufficient energy was produced in about 1.2 minutes to about 1.7 minutes depending on the transducer type used. Accordingly, all vehicles in all road types may produce sufficient energy to power the transmitter in about 0.3 minutes to about 1.2 minutes for one wireless transmission. The type two and type three transducers were low frequency transducers. Accordingly, it may be preferably to use a low frequency transducer.

[0115] Energy harvesting may be used in sporting goods. For example as illustrated in FIGS. **16**A and **16**B a test was conducted on a bicycle **200** to determine how long it would take to power a computer (not shown) using piezoelectric fibers. The computer was capable of performing several functions such as calculating speed, temperature, time, etc. To perform the test, a front fork **214** of the bike **200** was placed on a shaker **218** to generate vibration. The bike **200** was vibrated moderately from the front fork **214** at about 14 Hz. The piezoelectric was placed just under the fork **214**. As illustrated in FIG. **16**B, it took approximately 5 seconds to generate about 30 V. Because the particular computer being powered only requires between 3.5-5.0 V the voltage may have to be reduced using conditioning circuitry. The amount of generated power may be optimized to a particular application based on, for example, the source of vibration level and the location of the transducer.

[0116] While systems and methods have been described and illustrated with reference to specific embodiments, those skilled in the art will recognize that modification and variations may be made without departing from the principles described above and set forth in the following claims. Accordingly, reference should be made to the following claims as describing the scope of disclosed embodiments.

What is claimed:

1. A self-powered electronic device comprising:

a housing;

one or more electrical components disposed in said housing wherein one or more of said one or more electrical components comprise electrical loads;

electrical circuitry associated with operation of said self-powered electronic device, said electrical circuitry electrically connecting said one or more electrical components;

a piezoelectric ceramic material electrically coupled to one or more of said electrical loads of said self-powered electronic device, wherein said piezoelectric ceramic material harvests and converts mechanical energy into electrical energy for powering one or more of said electrical loads.

2. The device of claim 1, wherein the one or more electrical components further comprise low or ultra low power electronics.

3. The device of claim 1, wherein said piezoelectric ceramic material harvests and converts mechanical energy into electrical energy for powering one or more of said electrical loads without use of an external power supply and/or a replaceable battery.

4. The device of claim 1, further comprising an energy harvesting system for capturing usable amount of electric energy from ambient sources of mechanical energy associated with handling and operation of said self-powered electronic device.

5. The device of claim 1, wherein said piezoelectric ceramic material generates an electrical charge in response to an applied mechanical energy input resulting from one or more of human activity and/or operation of said self-powered electronic device.

6. The device of claim 1, wherein said piezoelectric ceramic material further comprises piezoelectric ceramic fibers.

7. The device of claim 6, wherein said piezoelectric ceramic fibers further comprise one or more of: a piezoelectric fiber composite (PFC); a piezoelectric fiber composite bimorph (PFCB); and/or a piezoelectric multilayer composite (PMC).

8. The device of claim 1, wherein said piezoelectric ceramic material further comprises one or more of: fibers, rods, foils, composites, and multi-layered composites.

9. The device of claim 1, further comprising a piezoelectric energy harvesting system, wherein said piezoelectric energy harvesting system further comprises:

said piezoelectric ceramic material; and

electrical circuitry electrically connecting said piezoelectric ceramic material to said one or more electrical loads, wherein said piezoelectric energy harvesting system reduces a dependency of said self-powered electronic device on external and/or replaceable power supplies.

10. The device of claim 9, wherein said piezoelectric energy harvesting system eliminates any dependency of said self-powered electronic device on external and/or replaceable power supplies

11. The device of claim 1, wherein said piezoelectric ceramic material further comprises flexible, high charge piezoelectric ceramic fibers produced using Viscose Suspension Spinning Process (VSSP).

12. The device of claim 1, wherein said piezoelectric ceramic material further comprise user defined shapes and/or sizes.

13. The device of claim 1, wherein said piezoelectric ceramic material is one or more of: embedded within, disposed within, and/or attached to said self-powered electronic device.

14. The device of claim 1, further comprising:

a device or structure associated with said self-powered electronic device;